

**COMPARISON OF ARAC PROPOSAL TO FAA PROPOSAL
FAR/JAR 25.1309**

In general, the FAA's proposal preserves the same intents that ARAC recommended. However, the FAA contents that there are opportunities for misunderstanding and misuse of the rules as worded by ARAC, and due to certain legal issues, the FAA makes the proposal as shown herein. All subjects below are discussed at greater lengths in the preamble of the NPRM, and in the "Issue Document", both of which are announced in the Federal Register. The tables below are a summary of the issues for easy reference.

Side-by-side comparison of the rules. The main differences are underlined for visibility and follow on discussion.

ARAC WORDING	FAA PROPOSED WORDING
<p>The requirements of this paragraph, except as identified below, are applicable, in addition to specific design requirements of JAR/FAR-25, to any equipment or system as installed in the aeroplane.</p> <p>Although this paragraph does not apply to the performance and flight characteristic requirements of Subpart B and the structural requirements of Subparts C and D, it does apply to any system on which compliance with any of those requirements is dependent.</p> <p>Certain single failures or jams covered by <u>25.671(c)(1) and 25.671(c)(3)</u> are excepted from the requirements of 25.1309(b)(1)(ii).</p> <p>Certain single failures covered by 25.735(b)(1) are excepted from the requirements of 25.1309(b).</p> <p>The failure effects covered by 25.810(a)(1)(v) and 25.812 are excepted from the requirements of 25.1309(b). The requirements of 25.1309(b) apply to powerplant installations as specified in 25.901(c).</p>	<p>Except as identified below, the requirements of this section are applicable, in addition to specific design requirements of part 25, to any equipment or system as installed in the airplane.</p> <p>Although this section does not apply to the performance and flight characteristic requirements of subpart B and the structural requirements of subparts C and D, it does apply to any system on which compliance with any of those requirements is dependent.</p> <p>Jams of flight control surfaces or pilot controls regulated under <u>§ 25.671(c)(3)</u> are excepted from the requirements of § 25.1309(b)(1) & (2).</p> <p>Single failures of the brake system regulated under § 25.735(b)(1) are excepted from the requirements of § 25.1309(b).</p> <p>The emergency egress and lighting system failure conditions regulated under § 25.810(a)(1)(v) and § 25.812 are excepted from the requirements of § 25.1309(b). The requirements of § 25.1309(b) apply to power plant installations as specified in § 25.901(c).</p>

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<p>(a) The aeroplane equipment and systems must be designed <u>and installed</u> so that:</p> <p>(1) Those required for type certification or by operating rules, or whose improper functioning would reduce safety, perform as intended under the aeroplane operating and environmental conditions.</p> <p>(2) Other equipment and systems <u>are not a source of danger in themselves</u> and do not adversely affect the proper functioning of those covered by sub-paragraph (a)(1) of this paragraph.</p>	<p>(a) <u>Except as provided for in paragraph (b) of this section or elsewhere within this subpart, the airplane equipment, systems and associated components, considered separately and in relation to other systems, must be designed and installed so that they perform as intended, retaining all normal functionality and capabilities, under the airplane operating and environmental conditions; and</u></p>
<p>(b) The aeroplane systems and associated components, considered separately and <u>in relation to other systems</u>, must be designed so that -</p> <p>(1) Any catastrophic failure condition</p> <p style="padding-left: 40px;">(i) is extremely improbable; and</p> <p style="padding-left: 40px;">(ii) does not result from a single failure; and</p> <p>(2) Any hazardous failure condition is extremely remote; and</p> <p>(3) Any major failure condition is remote.</p>	<p>(b) <u>The airplane equipment, systems and associated components, considered separately and in relation to other systems, must be designed and installed so that when they fail to perform as intended:</u></p> <p>(1) A <u>catastrophe</u>, considering <u>all</u> failure conditions:</p> <p style="padding-left: 40px;">(i) is <u>extremely remote</u>; and</p> <p style="padding-left: 40px;">(ii) does not result from a single failure; and</p> <p>(2) Each catastrophic failure condition is extremely improbable; and</p> <p>(3) Each hazardous failure condition is extremely remote; and</p> <p>(4) Each major failure condition is remote; and</p> <p>(5) <u>Each minor failure condition is infrequent; and</u></p> <p>(6) <u>All other failure conditions are shown to have no safety effect.</u></p>

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<p>(c) Information concerning unsafe system operating conditions must be provided to the crew to enable them to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. Systems and controls, including indications and annunciations must be designed to minimize crew errors which could create additional hazards.</p>	<p>(c) Information concerning unsafe system operating conditions must be provided to the crew to enable them to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. The required information must be provided by dedicated indication and/or annunciation whose characteristics are in accordance with §25.1322. Systems and controls, including indications and annunciations, must be designed to minimize crew errors that could create additional hazards.</p>
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Discussion and justification of the FAA proposal. Directly related issues are visually arranged for easy correlation.

ARAC PROPOSAL	FAA PROPOSAL	DISCUSSION
25.671(c)(1) [single failures in flt control systems] and (c)(3) [jams] are excepted from the proposed 25.1309 rules.	Only 25.671(c)(3) is excepted.	<p>JAR25.671(c)(1) allows probabilistic consideration for single failures. FAR25.671(c)(1) does not allow probability.</p> <p>The FAA does not allow any single failure in any system to be catastrophic. FAR25.671(c)(1) is consistent with the proposed 25.1309 harmonization with respect to not allowing single failures to be catastrophic, regardless of probability.</p> <p>Note: FCHWG is reviewing 25.671 and may have other recommendations.</p>
<p>The original “qualifiers” in paragraphs (a) and (b) are retained. These qualifiers are different from (a) [i.e. <i>installation</i>] to (b) [i.e. <i>“in relation to other systems”</i>].</p> <p>The qualifiers are not applied to (c).</p>	Use the same qualifiers for (a) and (b) as well as (c).	<p>The FAA believes the intent is to have the same qualifiers for (a) and (b). Eliminating the differences between (a) and (b) qualifiers have the following benefits:</p> <ul style="list-style-type: none"> • Avoid the misconception that (a) could be applied to individual pieces of equipment without considering them “in relation to other systems.” • Avoid the confusion that “installation” is only a requirement of (a).
Paragraph (a)(1) broadens the scope of this FAR to include all installed equipment.	The broader scope is already made possible in the introduction paragraph by referencing to “any equipment or system as installed in the airplane.” Hence it needs not be delineated again in paragraph (a).	

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<p>Paragraph (a) in general defines two classes of systems and equipment, and levies different standards to:</p> <p>(1)those that have safety effects, or are required by type certification or operating rules, and</p> <p>(2)those that do not in any way adversely affect the safety of the aircraft (“amenity” equipment).</p>	<p>The “no safety effects” requirement is presented as rule (b)(6). It is expected that a known source of danger will not be installed on the aircraft. But if any system or component inadvertently becomes a source of danger, then it has failed and the risks are regulated by (b). Similarly, when a system or component “adversely affects the proper functioning” of another system or component, then a failure has occurred and it will be covered by paragraph (b). Therefore, the FAA contents ARAC paragraph (a)(2) is not required.</p>	<p>The FAA is concerned that the phrase “not a source of danger in themselves” in the ARAC wording can be misused, and can negate the benefits of deleting 25.1301(d). The misuse of this phrase may cause unintentional complication in the design and installation of amenity equipment (for examples: wall-mounted telephones could only be installed in a recessed compartment to prevent causing injury to users in a turbulence, or footrests may not be allowed due to danger of tripping, etc...)</p>
<p>In lieu of 25.1301(d) which is deleted, paragraph (a)(2) is intended to allow manufacturers the benefits of reducing the costs of environmental qualification of the “amenities” to those tests necessary to verify that their presence do not interfere with the safe operation of the aircraft.</p>	<p>The FAA has added the phrase “retaining all normal functionality and capabilities” to stipulate that the requirement to “perform as intended” means no degradation in functionality and capability.</p>	<p>There has been a misconception that degradation in functionality and capability is not considered as a failure, and is somehow allowed under the existing 25.1301(d) and 25.1309(a).</p>

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<p>Paragraph (b) regulate the risks of catastrophic failures one condition at a time, as it has been the standard practice.</p>	<p>Add wording to limit the <i>total</i> risk of a <i>catastrophe</i>. This is the airplane-level risk that has historically been the <i>underlying principle</i> leading to the current regulation on catastrophic failure conditions (extremely improbable). A catastrophe is defined in the NPRM as “an occurrence resulting in multiple fatalities, usually with the loss of the airplane.”</p> <p>Limiting the Total Risk is also discussed in the Background section of the ARAC proposed AC/AMJ25.1309 where it is presented as an exception to the ARAC proposed rule for catastrophic failure conditions. However, the FAA contents Total Risk should be in the rule itself, and not in the advisory material, to avoid “rule making by AC”.</p>	<p>Same intent as proposed by ARAC’s AC/AMJ. Limiting the total risk of a catastrophe to being “extremely remote” should be viewed as codifying the intent of an <i>existing</i> requirement. The current practice is that if each catastrophic failure condition is limited (to 10^{-9}/flight-hour) then the total risk (10^{-7}/ft-hr or extremely remote) is <i>implied</i> to be met without further showing. Looking back at history, the current requirement was based on the arbitrary assumption that there are at most 100 potentially catastrophic failure conditions. The FAA contents that since the time this requirement was established (1970s), the trend has been increases in design complexity, and the 100-failures assumption may no longer be valid. Meeting the probability requirement on an individual failure condition basis does not necessarily result in meeting the intended cumulative risk requirement. Hence an airplane level safety assessment may be required if an airplane type has more than 100 of such failure conditions.</p>
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<p>Minor Failure Conditions are not mentioned in the rule. The AC/AMJ states that minor failure conditions may be “probable”, where a probable (in the qualitative sense) failure condition is one that is anticipated to occur one or more times during the entire operational life of each airplane.</p>	<p>Paragraph (b)(5) uses the term “infrequent” to regulate a minor failure condition, instead of the term “probable”. The FAA defines (qualitatively) an infrequent failure condition as one that is not anticipated to occur to <u>each airplane every year</u>, but may occur one or more times during the entire operational life of each airplane. The FAA proposes that the frequency of Minor failure conditions needs to be qualitatively limited, in the case where no numerically assessment is performed.</p>	<p>The term "probable" and its <i>qualitative</i> probability definition in the AC/AMJ place no limit on the maximum acceptable frequency of occurrence of a failure condition. Service experience has shown that a percentage of minor failure conditions actually resulted in more severe effects (e.g. rather frequent failures such as autothrottle malfunction or single-engine in-flight shutdown have occasionally resulted in loss of an aircraft.) Because the less severe failure conditions (Minor & Major) are much more numerous than the number of Hazardous/Catastrophic failure, they can have an influential effect on the overall accident rate.</p>
	<p>The FAA adds the sentence “If not provided by inherent airplane characteristics, the required information must be provided by dedicated indications and/or annunciations whose characteristics are in accordance with §25.1322.”</p>	<p>Because the ARAC recommended AC/AMJ lists the forms (warning, caution, advisory, message) in which the indications and/or annunciations are “required” to be, there exists a legal issue of “rulemaking by AC” which the FAA is not allowed to violate. In order to preserve the intent of the AC, the FAA needs to link 25.1309(c) to 25.1322. Furthermore, the current 25.1322 does not specifically require any indication/annunciation be provided. It only specifies the forms of the indications/annunciations IF they are provided. The FAA proposed 25.1309(c) would require that they are provided. Lastly, the Avionics Harmonization Working Group is revising 1322, and will provide more guidance to this subject.</p>